UNIVERSITI PUTRA MALAYSIA

GROWTH AND YIELD OF TWO FORAGE LEGUMES OF CONTRASTING GROWTH HABITS UNDER SHADE

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By

PENSRI SORNPRASITTI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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DEDICATION

To my beloved father and mother

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Doctor of Philosophy

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Chairman : Associate Professor Mohd Ridzwan Abd. Halim, Ph.D.

Faculty : Agriculture

A study was conducted to evaluate the responses of two forage legumes *Arachis pintoi* Krapov. & D. Gregory (Arachis) and *Stylosanthes guianensis* (Aublet) Sw. (Stylo), of contrasting growth habits (prostrate and erect type) to levels of shade. Treatments used over three experiments included three radiation regimes (30, 50 and 100% light transmission), two cutting intervals (6 and 8 week), two cutting heights (5 and 10 cm) and the removal of residual leaves on yield and growth of the plants.

Both species had reduced yield with increased shading but Stylo showed greater reduction in yield with shade compared to Arachis. Under full sunlight, Stylo performed better giving a 43 percent greater yield than Arachis. On the other hand, Arachis yielded 6 percent more than Stylo under both shaded treatments, indicating

that the prostrate habit made the plant more tolerant to shading. Arachis also had a greater leaf/stem ratio, and better nodulation under shade than Stylo. The better nodulation of Arachis under shade compared to Stylo may have attributed to the greater shade tolerance of Arachis.

Both legumes were affected by cutting interval; the longer cutting interval of 8 weeks gave higher yield than the 6 weeks cutting interval (increase of 20.7 percent for Arachis and 36.5 percent for Stylo). On the other hand, nutritive quality was better for both legumes with the shorter cutting interval. Increased frequency of cutting reduced plant persistence of Stylo by 8.8 percent while that of Arachis increased by 26 percent, showing that the legumes with the prostrate habit is more tolerant to frequent cutting.

Cutting height had significant effect on yield of Stylo and Arachis under shading, both giving higher yield under 10 cm cutting height than 5 cm cutting height. Stylo showed a greater reduction in yield (40%) than Arachis (17.1%) with the lower cutting height. This proved that the prostrate habit made the plant more tolerant of low cutting height than the upright habit.

The presence of residual leaves was more important for regrowth of Arachis than for Stylo. In Stylo, plant regrowth was influenced by cutting height irrespective of the presence or absence of residual leaves. On the other hand, in Arachis, plants

cut at the low cutting height gave similar regrowth with those at the higher cutting height as long as residual leaves are retained.

In conclusion, the upright legume, Stylo was less tolerant to shading than the prostrate legume Arachis. The latter should be a more suitable legume for use under the integration system where forages are grown under the plantation crops. Arachis is also more tolerant to intensive defoliation as shown by its better ability to withstand shorter cutting interval and lower cutting height than Stylo.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

TUMBESARAN DAN HASIL DUA FORAJ KEKACANG YANG BERLAINAN TABIAT TUMBESARAN DI BAWAH NAUNGAN

Oleh

PENSRI SORNPRASITTI

November 2004

Pengerusi : Profesor Madya Mohd Ridzwan Abd. Halim, Ph.D.

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Satu kajian telah dilaksanakan untuk menilai respons dua kekacang foraj *Arachis pintoi* Krapov. & D. Gregory (Arachis) and *Stylosanthes guianensis* (Aublet) Sw. (Stylo) yang berlainan tabiat tumbuhan (melata dan tegak) terhadap aras naungan. Perlakuan-perlakuan yang digunakan dalam tiga eksperimen termasuk aras radiasi (30, 50 dan 100 % sinaran cahaya), dua selang masa pemotongan (6 dan 8 minggu), dua aras pemotongan (5 dan 10 cm) dan pembuangan baki daun terhadap hasil dan tumbesaran tanaman.

Hasil kedua-dua spesies menurun dengan peningkatan naungan tetapi Stylo menunjukkan penurunan hasil yang lebih ketara dari Arachis. Di bawah sinaran cahaya penuh, Stylo menunjukkan prestasi yang lebih baik dengan hasil 43 peratus lebih tinggi dari Arachis. Sebaliknya, Arachis mendapat hasil enam peratus lebih

tinggi dari Stylo di bawah kedua-dua perlakuan naungan, menunjukkan tabiat melata membuatkan tumbuhan lebih toleran terhadap naungan. Arachis juga mempunyai nisbah daun/batang dan nodulasi yang lebih tinggi dari Stylo. Keupayaan Arachis membentuk nodul di bawah naungan mungkin menyebabkannya lebih toleran terhadap naungan berbanding Stylo.

Kedua-dua kekacang dipengaruhi oleh selang masa pemotongan; selang masa yang lebih lama, 8 minggu, memberikan hasil yang lebih tinggi dari selang masa 6 minggu (peningkatan 20.7 peratus bagi Arachis dan 36.5 peratus bagi Stylo). Sebaliknya, kualiti pemakanan adalah lebih baik dengan selang masa yang lebih singkat. Peningkatan kekerapan pemotongan juga merendahkan ketahanan Stylo 8.8 peratus manakala ketahanan Arachis meningkat 26 peratus, menunjukkan kekacang tabiat melata lebih toleran terhadap pemotongan kerap.

Aras pemotongan menunjukkan kesan bererti terhadap hasil Stylo dan Arachis di bawah naungan, kedua-dua menunjukkan hasil yang lebih tinggi pada aras pemotongan 10 cm berbanding dengan 5 cm. Stylo menunjukkan penurunan hasil yang lebih ketara (40 peratus) berbanding Arachis (17.1 peratus) dengan aras pemotongan rendah. Ini membuktikan tabiat melata membuatkan tumbuhan lebih toleran terhadap pemotongan rendah.

Kehadiran daun-daun baki adalah lebih penting untuk tumbesaran semula Arachis daripada tumbesaran semula Stylo. Bagi Stylo, tumbesaran semula dipengaruhi

oleh aras pemotongan sama ada daun baki dibuang atau tidak. Sebaliknya, bagi Arachis, tumbuhan yang dipotong rendah dapat tumbuh semula dengan kadar yang sama dengan yang dipotong tinggi selagi daun baki tidak dibuang.

Kesimpulannya, kekacang jenis tegak, Stylo, adalah kurang toleransi terhadap naungan berbanding dengan kekacang melata Arachis. Arachis lebih sesuai digunakan sebagai kekacang untuk ditanam di bawah sistem integrasi yang melibatkan penanaman foraj di bawah tanaman perladangan. Arachis juga lebih toleran terhadap defoliasi intensif berbanding Stylo, seperti yang ditunjukkan dari keupayaannya untuk bertahan di bawah pemotongan yang kerap dan aras pemotongan yang rendah.

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I certify that an Examination Committee met on 3rd November 2004 to conduct the final examination of Pensri Sornprasitti on her Doctor of Philosophy thesis entitled "Growth and Yield of Two Forage Legumes of Contrasting Growth Habits under Shade" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

Pensri Sornprasitti

PENSRI SORNPRASITTI

Date: 31-12-2004

TABLE OF CONTENTS

LIST OF TABLES

Table		Page

LIST OF FIGURES

Figure **Page**

LIST OF PLATES

CHAPTER I

INTRODUCTION

In Southeast Asian countries, plantation agriculture is an important form of utilisation of land. In Malaysia, for example, more than three million hectares of land are under major plantation crop production (e.g., oil palm, rubber, coconut, and fruit orchard). The plantation area is increasing especially for oil palm (Tajuddin and Wan Zahari, 1992; Department of Agriculture, 2003).

Livestock integration with plantation crops offers great advantage because the forage plants between the plant rows provides extensive grazing for ruminants. Ruminants also help in weed control in the plantations, and increase land use efficiency by reducing the weeding cost from 18 to 38% compared to the use of herbicides and human labour (Tajuddin and Chong, 1994). Thus livestock production under plantation crops has become a popular system. Integration of ruminant livestock in plantations has been reported to be successful with cattle (Dahlan, 1989; Chen, 1992); sheep (Rajion et al., 1994; Haji Baba et al., 1998); goat (Haji Baba et al., 1998), and buffalo (Nordin and Abdullah Sani, 1996; Jayatileka et al., 1998).

Oil palm, rubber, and coconut are normally planted at wide row spacing. During the early establishment of these plants (up to 5 years), the interrow-spaces are